WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2002SD1B

Title: Arsenic Remediation of Drinking Water: Phase III

Project Type: Research

Focus Categories: Treatment, Toxic Substances, Water Quality

Keywords: Adsorption and Exchange, Arsenic, Geochemistry, Ground-Water Quality, Water Chemistry, Water Quality, Water Quality Standards, Water Treatment

Start Date: 03/01/2002

End Date: 02/28/2003

Federal Funds Requested: $9,147

Non-Federal Matching Funds Requested: $18,294

Congressional District: First

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Abstract

Removal of arsenic from drinking water is a serious problem facing many water supplies in the United States. Arsenic retention and mobility in surface water and ground water are of great concern because of toxic effects on the environment. Arsenic is a persistent, bio-accumulative toxin. The U.S. Environmental Protection Agency announced in November, 2001, that the drinking water standard for arsenic, formerly 50 parts per billion (ppb), will be lowered to 10 ppb by 2006 because of links to cancer. Current remediation technologies are expensive. Thus, any lowering of the standard will put increased economic pressure on rural communities with high levels of arsenic in their drinking water. The American Water Works Association has estimated the cost of decreasing the arsenic standard to 10 ppb in South Dakota at $8.25 million.

The objectives of this work are to: (1) determine the surface chemistry of adsorption and precipitation processes that operate during the interaction between limestone and arsenic; (2) test methods for improved arsenic retention, including effects of pulverizing and sintering of limestone as well as magnesium-carbonate treatment; and (3) recommend practical options for long-term disposal of the waste in a benign form such as encasement in concrete.

The proposed research has the potential to reduce arsenic in drinking water at the source, with the added benefit of low-cost disposal of a stable and benign waste product in ordinary landfills. In earlier phases of this on-going work sponsored by the USGS-104 program, research by the principal investigators demonstrated arsenic adsorption of greater than 90% by limestone. The next phase of this work, proposed herein, will establish the surface chemistry of the arsenic removal process and investigate ways of improving the efficiency of the process as well as waste disposal options. We anticipate the development of

a remediation technology that will significantly concentrate the arsenic onto limestone. Treatment of large quantities of water with arsenic above drinking water standards should produce a relatively small and compact amount of solid limestone with adsorbed arsenic. Arsenic retention by limestone appears to be an effective process that offers great potential for source reduction. Because of the ready availability of limestone, its use for arsenic remediation would be relatively inexpensive. If successful, the technology could be readily adapted to small rural water supply systems as well as private, domestic, and stock wells. For example, elevated levels of arsenic in water from wells in the Arikaree aquifer have been observed on the Rosebud Indian Reservation as well as other parts of South Dakota. Benefits of this research will include a low-cost treatment technology for source reduction that will reduce arsenic to levels below 10 ppb, helping operators of small or rural water supply systems to meet the new, lowered maximum contaminant level for arsenic.

Additional benefits of this research include the potential for low-cost disposal of the waste product in a stable form. During earlier phases of this research, the Toxicity Characteristic Leaching Procedure (TCLP) was conducted on two samples of limestone waste from column tests, following methods outlined by EPA protocol SW-846-1311. The leaching potential of the waste was lower than the new maximum contaminant level of 10 ppb for arsenic, so the waste appears to be stable and potentially could be placed in a landfill. Commercial application of the technology could be available within two years.